

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
27 September 2001 (27.09.2001)

PCT

(10) International Publication Number
WO 01/71397 A1

(51) International Patent Classification⁷: **G02B 5/12**

(21) International Application Number: PCT/US00/07538

(22) International Filing Date: 21 March 2000 (21.03.2000)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant and

(72) Inventor: **REIFFEL, Leonard** [US/US]; 602 Deming Place, Chicago, IL 60605 (US).

(74) Agent: **MOYER, Donald**; 431 S Dearborn 705, Chicago, IL 60605 (US).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE,

DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

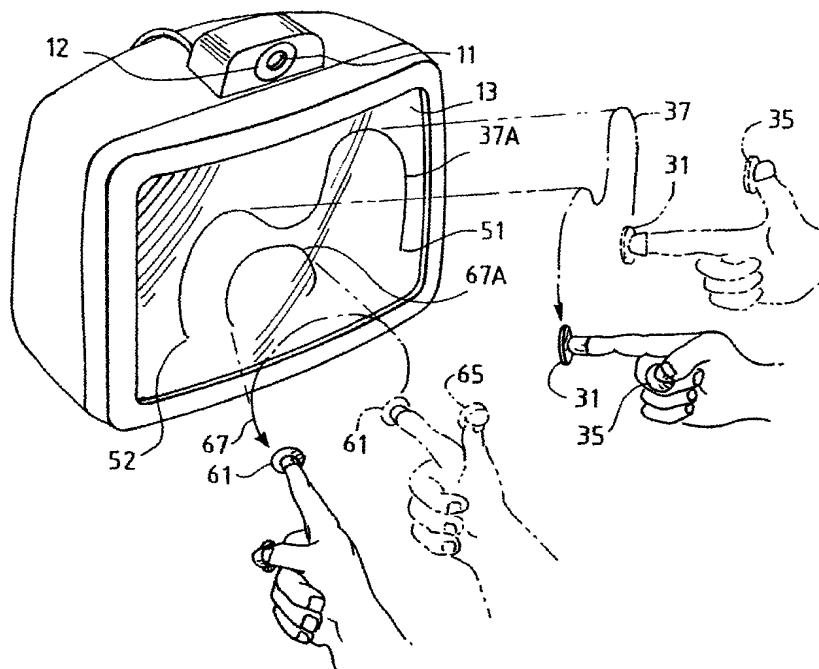
(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: MULTI-USER RETRO REFLECTOR DATA INPUT



(57) Abstract: The apparatus uses retro-reflected light, having a fixed component (41) and a variable component (37) varied by a person, from a retro reflector (31) connected to a person to input data (37A) to an information system (13) and does this for each of several persons in the same time interval.

TITLE

Multi-user Retro Reflector Data Input

BACKGROUND

The invention uses retro-reflected light having a fixed component and a
5 variable component varied by a person, from a retro reflector connected to a
person to input data to an information system and does this for each of several
persons in the same time interval.

Limits of data input via retro-reflected light - for example by Honey in U.
S. Patent 5,912,700 and by Stuart in U. S. Patent 4,998,441 - are surmounted by
10 the discovery shown here.

SUMMARY

Light retro-reflected by a retro reflector connected to a person has a fixed
component and a variable component and is detected by an imager which inputs
data to an information system.

15 Other forms and objects of the invention will be comprehended in the
drawings and description, which will make further equivalent forms and objects
obvious hereafter to persons skilled in the art.

DRAWINGS

FIG. 1 shows two users inputting data to an information system.

FIG. 2 shows light retro-reflected from a retro reflector in FIG. 1.

FIG. 3 shows light retro-reflected from a sequent retro reflector in FIG. 1.

5 FIG. 4 shows a retro reflector on a card.

FIG. 5 shows a finger acting as a retro reflector and retro reflector parts on a cylinder.

DESCRIPTION

The data input apparatus is used with an information system indicated by
10 the display device **13** in FIG. 1. The data input apparatus comprises an imager indicated by a lens **11**, a light source indicated by a ring light **12**, and a retro reflector indicated by a retro-reflecting disc **31** on a hand portion of a person.

Though the retro reflector is on the person in the example of FIG. 1, the retro reflector can be connected to the person in various ways such as by being
15 held by the person, by being on gear worn by the person, or by being on a device - such as an aircraft - transporting the person. The meaning of "connected to a person" here is distinct from connection by a signal.

Throughout use for data input, the retro reflector remains connected to the person. This is distinct from the case where retro-reflecting material is attached
20 to an object - such as a thrown ball - which moves independently of the person.

Ideal retro-reflecting objects retro-reflect all incident light back coaxially along the path of the incident light. Thus, an imager adjacent to the light source will detect retro-reflected light - which is light from the light source retro-reflected by the retro reflector to the imager - with a high signal to noise ratio
5 between the retro-reflected light and any other light detected by the imager. The signal to noise ratio becomes greater and smaller as retro-reflecting objects are more and less ideal.

"Adjacent" here means that the retro-reflected light is within the field of view of the imager. A light beam from the source and the retro-reflected light
10 beam incident on the imager can be made precisely coaxial by using beam splitting devices, and this also is included in the meaning of "adjacent" here.

"Detect" here means that the imager locates the retro reflected light relative to the imager field of view - for example, as exposing specific pixels of a charge coupled device.

15 The retro-reflected light has a fixed component indicated for example by **41** in FIG. 2 which depicts retro-reflected light seen by the imager. The retro-reflected light also has a variable component which is varied by the person.

One example of the variable component is indicated by the path **37** along which the person moves the retro reflector. Another example of the variable
20 component is indicated by a second retro reflector part **35** being first positioned

to be seen **45** by the imager and later being positioned to be not visible to the imager.

A multiplicity of distinct variations of the variable component - comprising data - can be generated by the person varying positions of a retro reflector and varying configurations of more than one retro reflector part. This meaning of a variable component is distinct from the case where a person moves a bar-coded object so that an imager can read the fixed bar code.

When, in a time interval, the imager detects the variable component, the imager inputs a signal to the information system.

In the example depicted in FIG. **1** a variable component corresponds to the series of positions making up the path **37**, and the sequent signal comprises data identifying the series of positions along the path **37** in the time interval.

Also in the example depicted in FIG. **1** a variable component is a start configuration of the retro reflector **31** and the second retro reflector part **35** at the start of the path and is a stop configuration with the second retro reflector part obscured at the end of the path. The start configuration could be mapped by the imager as a start signal causing the information system to start **51** a trace **37A** corresponding to the path, and the stop configuration could be mapped by the imager as a stop signal causing the information system to stop **52** the trace corresponding to the path.

Start and stop signals to start the trace and to stop the trace could also be input by other means such as key strokes, mouse clicks, and speech.

The information system need not visually display the trace, as the trace could be data used or stored by the information system. The trace could be in
5 three spatial dimensions, and in time, in data used or stored by the information system. A second imager with light source, and more, could be used to help generate three dimensional data. Also, a wand-like retro reflector with two distal points separated by a known distance can be used to facilitate three dimensional data.

10 When, in the time interval, the imager detects the fixed component, **41** for example, the imager inputs an identity signal to the information system.

In the example depicted in FIG. 1 there is also a sequent retro reflector **61** connected to a sequent person, and there is sequent retro-reflected light with a sequent fixed component **71** depicted in FIG. 3.

15 When, in the time interval, the imager detects the sequent fixed component **71** the imager inputs a sequent identity signal to the information system. The fixed components **41** and **71** are distinct, and thus the sequent identity signal is distinct from the identity signal.

The sequent retro-reflected light also has a sequent variable component
20 varied by the sequent person. One example of the sequent variable component is indicated by the path **67** along which the sequent person moves the sequent retro

reflector **61**. Another example of the sequent variable component is indicated by a sequent second retro reflector part **65** being first positioned to be seen **75** by the imager and later being positioned to be not visible to the imager.

When, in the time interval, the imager detects the sequent variable
5 component, the imager inputs a sequent signal to the information system.

In the example depicted in FIG. 1 a sequent variable component corresponds to a series of positions making up the sequent path **67**, and the sequent signal comprises data identifying the series of positions along the sequent path **67** in the time interval. The sequent signal can cause the
10 information to trace a path **67A**.

The retro reflector and the sequent retro reflector function interchangeably. The contents of the fixed component and the sequent fixed component are distinct. The contents of the variable component and the sequent variable component are varied by distinct persons and can be distinct.

15 An imager can distinguish retro-reflected light - **45** and **41** for example - retro-reflected by a person from retro-reflected light - **75** and **71** for example - retro-reflected by a sequent person because of the distinct fixed components and because distances between retro-reflected light retro-reflected by one person - **45** and **41** for example - are smaller than distances between retro-reflected light
20 retro-reflected light not retro-reflected from by one person - **45** and **75** for example.

While 71 is shown to have bar code like configurations, other properties - such as shape and color - can also be used alone and in combinations to comprise fixed components.

In FIG. 1 the retro reflector is shown as a retro-reflecting disc attached to
5 finger tips. Retro-reflecting objects can be attached to each of the fingers and to other portions of a hand such as knuckles and to other portions of the body. Various commercial retro reflecting materials - utilizing micro spheres and embossments for example - produce very high signal to noise ratios and can be put on hand portions in various ways - such as with adhesive, with rings, and
10 with thimble-like devices.

A retro reflector on a card 87 which can be held by a person is depicted in FIG. 4. A variable component is produced when the person obscures - with fingers, for example - one or more of retro-reflecting parts 81, 82, and 83. A fixed component comprises a set of retro-reflecting parts 85.

15 A retro reflector can be attached to a persons gear - head gear for example - so that positions of the person can be imaged from above to identify the person and trace the positions. An information system can attach an identifying label to a displayed image of the person. When many persons are so imaged, only selected traces can be displayed and can be color coded. Paths of players in a
20 sporting event can be traced.

A retro reflector can be attached to a first aircraft transporting a person so that a light source and imager on a second aircraft can detect the presence and motion of the first aircraft.

In as much as a finger tip reflects light from the light source back to the imager with a signal to noise ratio greater than one, the finger tip - **31A** depicted in FIG. **5** for example - can be used in place of the retro reflector **31** though a poor signal to noise ratio will burden the imager. While finger tip properties - such as color - can provide the fixed component, this would further burden an imager. A fixed component - such as the retro-reflecting stripes **85A** around a cylinder shown in FIG. **5** - burdens the imager less.

The signal to noise ratio provided by a retro reflector can be increased. For example, a retro reflector can reflect a first electromagnetic radiation spectrum portion greater than other electromagnetic radiation spectrum portions, and the imager can be more sensitive to the first electromagnetic radiation spectrum portion than to other electromagnetic radiation spectrum portions.

Also, the light source can be modulated at a first frequency and the imager can be more sensitive to light modulated at the first frequency than to light modulated at other frequencies. With a modulated light source the distance between a retro reflector and the imager can be determined by time of flight measurement.

A scanner can be added. The scanner can be an imager scanner scanning the imager over a light source illuminated; can be a light scanner scanning the light source over an imager viewed solid angle; and can be a combined scanner scanning the imager and the light source together over a solid angle.

- 5 Combinations of all the several signal to noise ratio improvement methods can be used.

Information processing capacity needed to detect the retro reflectors and generate inputted data can be incorporated in the imager itself so that the imager can input data to the information system in forms similar to forms provided by
10 keystrokes and mouse devices. Information processing capacity of the information system can be used to detect retro reflectors and generate inputted data, in which case the information system is part of the imager while it is helping generate input data.

Variations of the variable component - such as range and speed of motion
15 and relative configurations and motions of retro reflector parts - can be defined to execute members of a roster of signal components similarly to defining keystroke combinations.

The apparatus can be utilized interactively. For example, in response to a query communicated by the information system, a plurality of persons can input
20 responses. Also, for each of a plurality of persons navigating a territory, the information system can communicate to each of the persons a person specific

path from the location of each of the persons to a part of the territory sought by each of the persons.

The data processor can locate the retro reflector relative to a target object.

The target object position can be determined by another retro reflector data input

5 apparatus. The target object could be a game animal and this would enable realistic bloodless hunting. The target object could be another person and this would enable bloodless combat training and sport.

Other equivalent forms for the imager, the light source, the retro reflector, the fixed component, the variable component, the identity signal, and the signal;

10 and other equivalent ways of using a retro reflector to input data to an information system will be obvious hereafter to persons skilled in the art.

Therefore this invention is not limited to the particular examples shown and described here.

CLAIMS

What is claimed is:

1. Data input apparatus used with an information system, the data input apparatus comprising:

- 5 an imager;
- a light source adjacent to the imager;
- a retro reflector, the retro reflector being connected to a person;
- retro-reflected light, the retro reflected light being light from the light
- source which is retro-reflected by the retro reflector to the imager,
- 10 the retro-reflected light having a fixed component, and the retro-
- reflected light having a variable component varied by the person;
- an identity signal, the identity signal being input to the information
- system by the imager when the fixed component is detected by the
- imager in a time interval; and
- 15 a signal, the signal being input to the information system by the imager
- when the variable component is detected by the imager in the time
- interval.

2. The apparatus of claim 1 further comprising:

a sequent retro reflector, the sequent retro reflector being connected to a sequent person;

sequent retro-reflected light, the sequent retro reflected light being light

5 from the light source which is retro-reflected by the sequent retro reflector to the imager, the sequent retro-reflected light having a sequent fixed component, and the sequent retro-reflected light having a sequent variable component varied by the sequent person;

a sequent identity signal, the sequent identity signal being input to the

10 information system by the imager when the sequent fixed component is detected by the imager in the time interval;

a sequent signal, the sequent signal being input to the information system by the imager when the sequent variable component is detected by the imager in the time interval.

15 3. The apparatus of claim 1 wherein the retro reflector reflects a first electromagnetic radiation spectrum portion greater than other electromagnetic radiation spectrum portions and the imager is more sensitive to the first electromagnetic radiation spectrum portion than to the other electromagnetic radiation spectrum portions.

4. The apparatus of claim 1 wherein the light source is modulated at a first frequency and the imager is more sensitive to light modulated at the first frequency than to light modulated at other frequencies.

5. The apparatus of claim 1 further comprising a scanner chosen from the group consisting of:

an imager scanner scanning the imager over a light source illuminated solid angle;

a light scanner scanning the light source over an imager viewed solid angle; and

a combined scanner scanning the imager and the light source together over a solid angle.

6. The apparatus of claim 1 wherein the retro reflector is on a hand portion of the person.

7. The apparatus of claim 1 wherein the retro reflector is on an object held by the person.

8. The apparatus of claim 1 wherein the retro reflector is on gear worn by the person.

9. The apparatus of claim 1 wherein the retro reflector is on a vehicle transporting the person.

10. Data input apparatus used with an information system, the data input apparatus comprising:

an imager;

a light source adjacent to the imager;

5 a retro reflector, the retro reflector being connected to a person;

retro-reflected light, the retro reflected light being light from the light

source which is retro-reflected by the retro reflector to the imager,

the retro-reflected light having a fixed component, and the retro-

reflected light having a variable component varied by the person;

10 an identity signal, the identity signal being input to the information

system by the imager when the fixed component is detected by the

imager in a time interval;

a signal, the signal being input to the information system by the imager

when the variable component is detected by the imager in the time

15 interval;

a sequent retro reflector, the sequent retro reflector being connected to a

sequent person;

sequent retro-reflected light, the sequent retro reflected light being light

from the light source which is retro-reflected by the sequent retro

20 reflector to the imager, the sequent retro-reflected light having a

sequent fixed component, and the sequent retro-reflected light
having a sequent variable component varied by the sequent person;
a sequent identity signal, the sequent identity signal being input to the
information system by the imager when the sequent fixed
5 component is detected by the imager in the time interval; and
a sequent signal, the sequent signal being input to the information system
by the imager when the sequent variable component is detected by
the imager in the time interval.

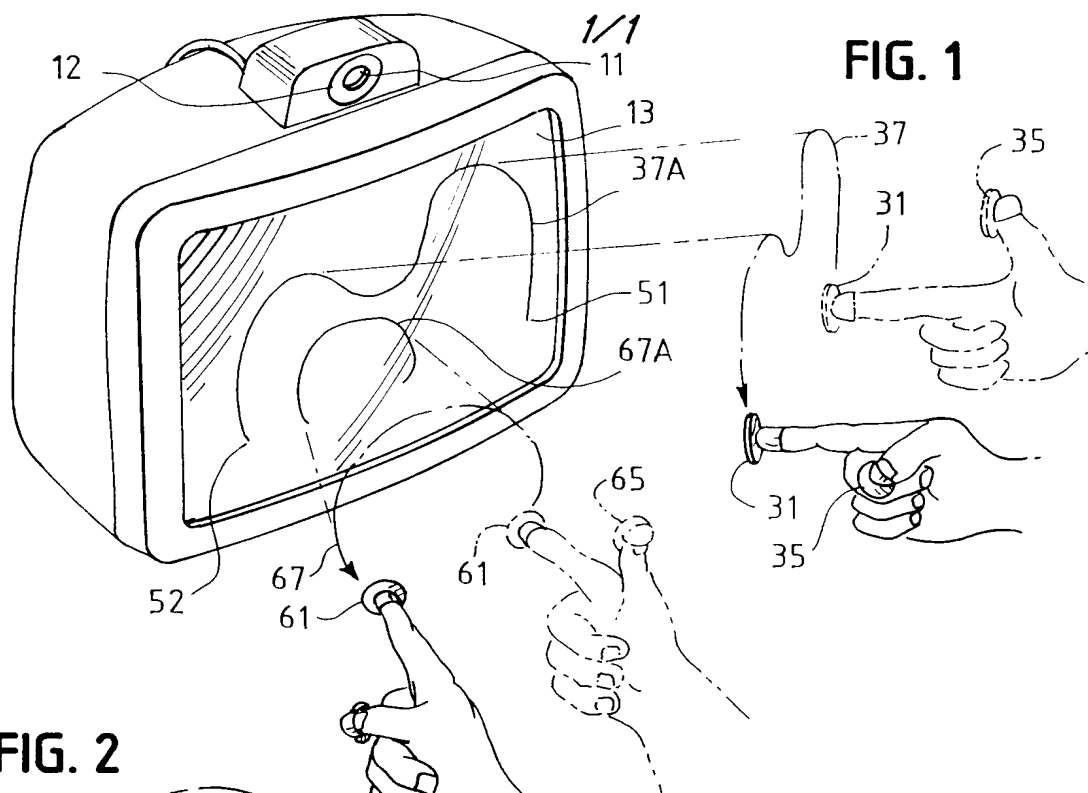


FIG. 1

FIG. 2

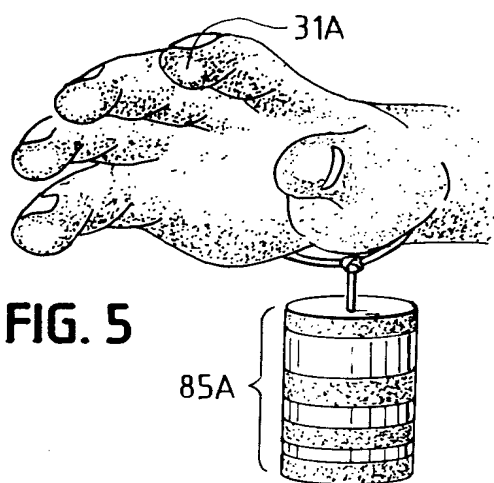
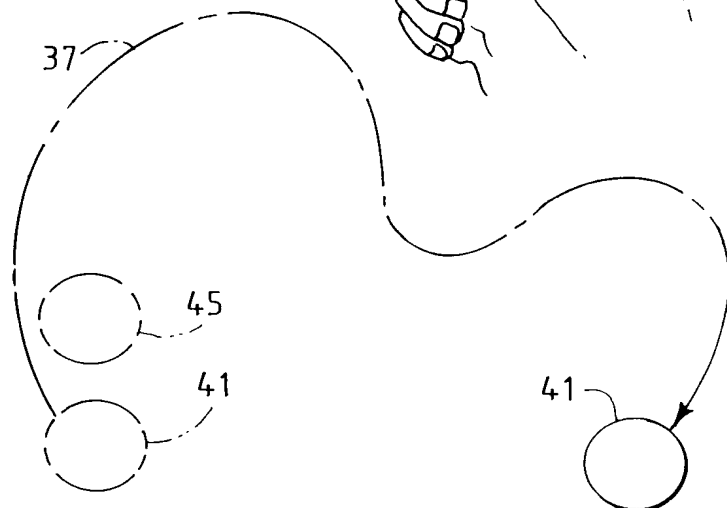


FIG. 5

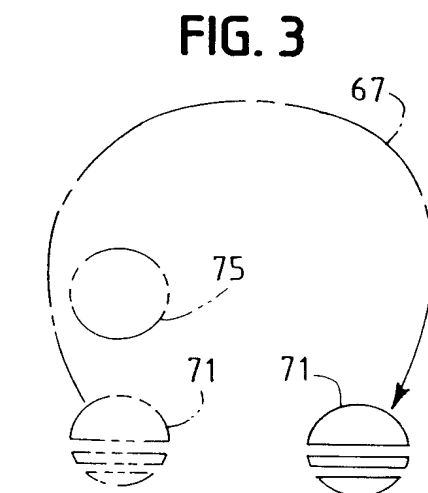


FIG. 3

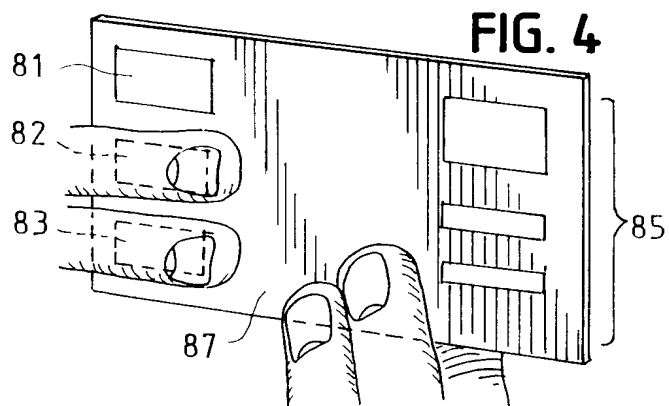


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/07538

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G02B 5/12
US CL : 359/515, 516, 517, 520, 533; 116/209
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 359/169, 170, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 533; 116/209; 356/152.3

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EAST

Search terms: imager, retroreflect, detect, (fixed component), (variable component)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---- A	US 4,053,233 A (BIEN et al) 11 October 1977 (11.10.1977), Figs. 3-4.	1, 3-5, 8-9 ----- 2, 6-7, 10
X ----- A	US 4,099,050 A (SAUERMANN) 04 July 1978 (04.07.1978), Figs. 1-3 and the accompanying text.	1, 3-4, 7 ----- 2, 6, 10

☐

Further documents are listed in the continuation of Box C.

☐

See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

03 JUNE 2000

Date of mailing of the international search report

11 July 2000 (11.07.00)

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703) 305-3230

Authorized officer:

JAMES PHAN

Telephone No. (703) 308-4810